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INTERNATIONAL RICE RESEARCH INSTITUTE

Centre de coopération internationale en recherche agronomique pour le development

CIRAD

Montpellier, France

Can higher grain yield be achieved in irrigated rice fields through desirable nursery management?

Tanguy Lafarge
Zuziana Susanti, Estela Pasuquin
CSSP, 10 May 2006, Palawan

Nursery management in farmers' fields

- **Transplanting 20 to 30 days-old seedlings (7 to 10-leaf stage)**
  - Farmers prefer to transplant old seedlings
  - High tiller mortality if early transplanting may induce significant dry matter loss

- **Sowing in the nursery from 3000 to 10000 seeds m^{-2} (75 to 250 g seeds m^{-2})**

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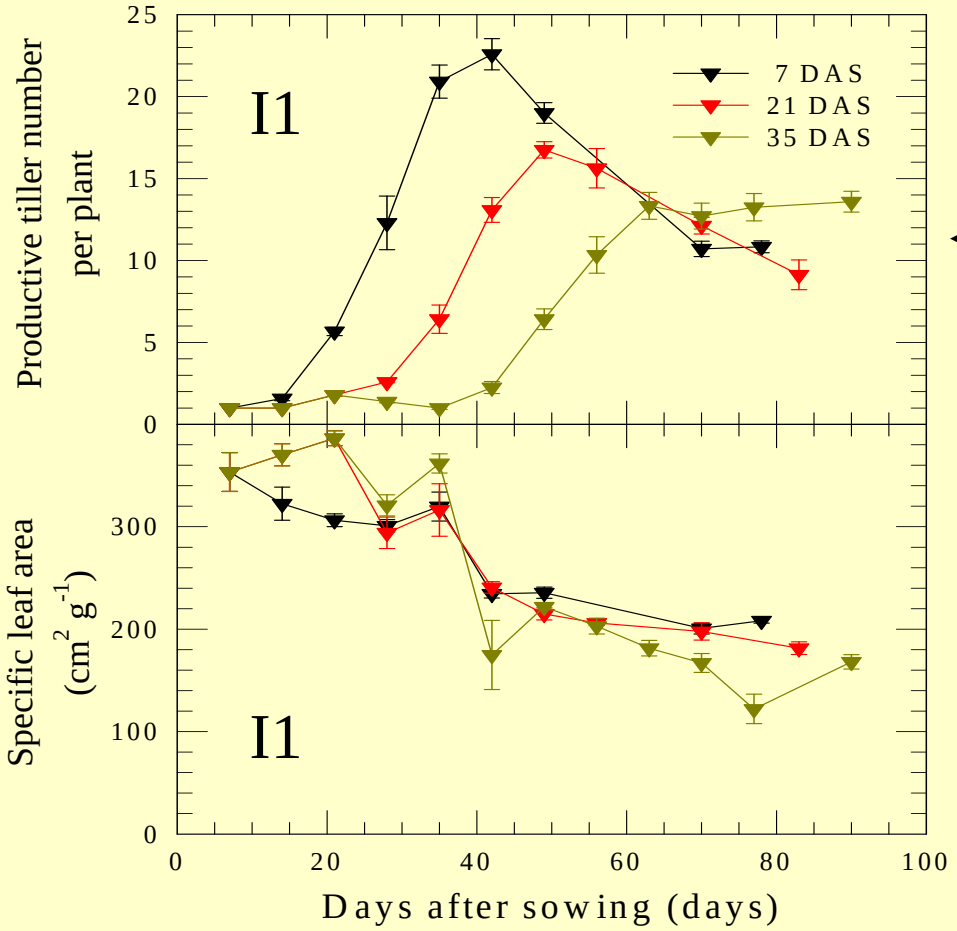
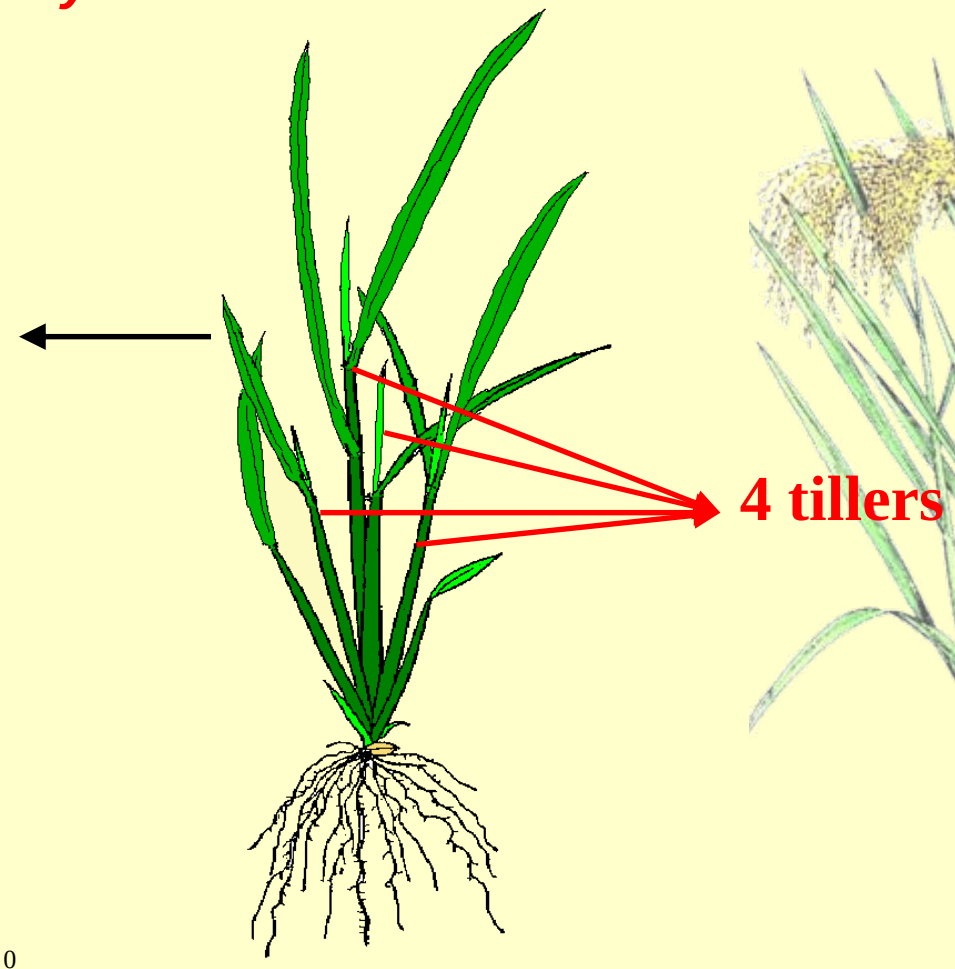
Plant response to transplanting age

Transplanting age: 7, 21 and 35 days

Nursery density: 3000 seeds m^{-2}





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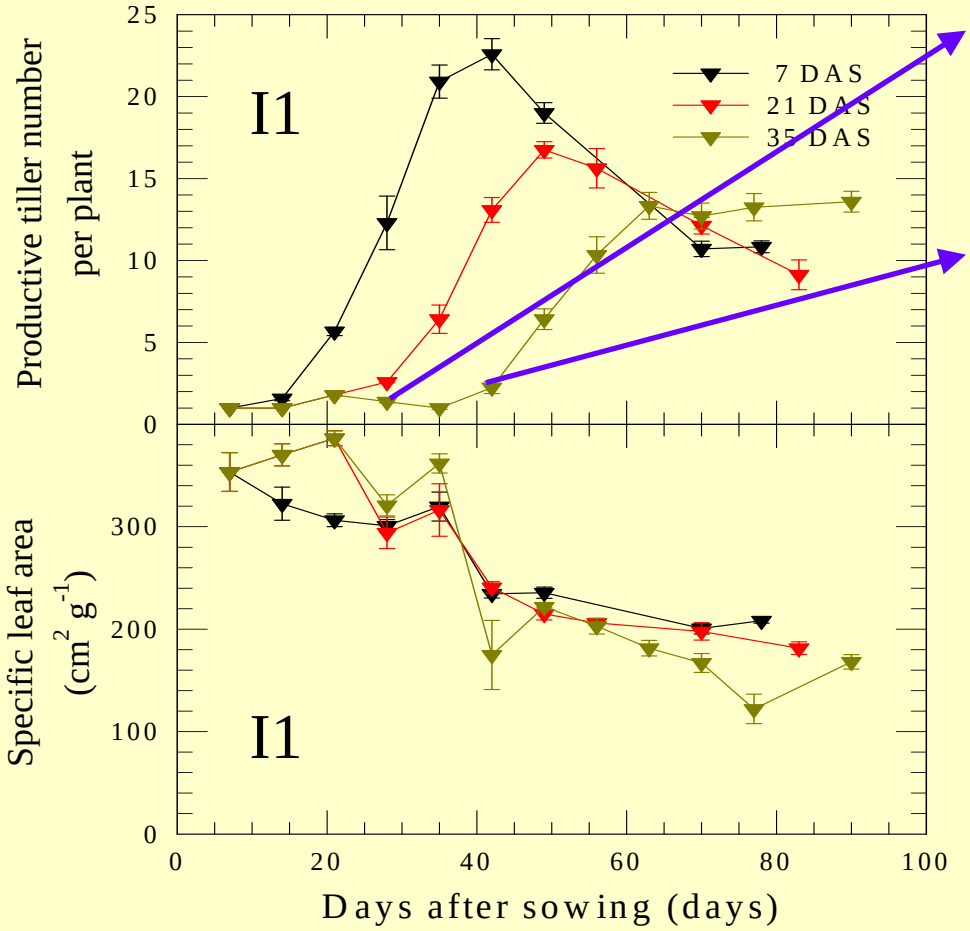
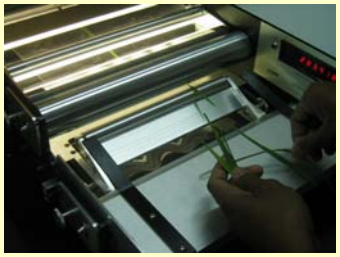


- Tiller emergence was delayed if extended stay in the nursery

- Tiller emergence resumed right after transplanting whatever the age

Calculation of specific leaf area



$$SLA = \frac{\text{leaf area}}{\text{leaf dry weight}}$$

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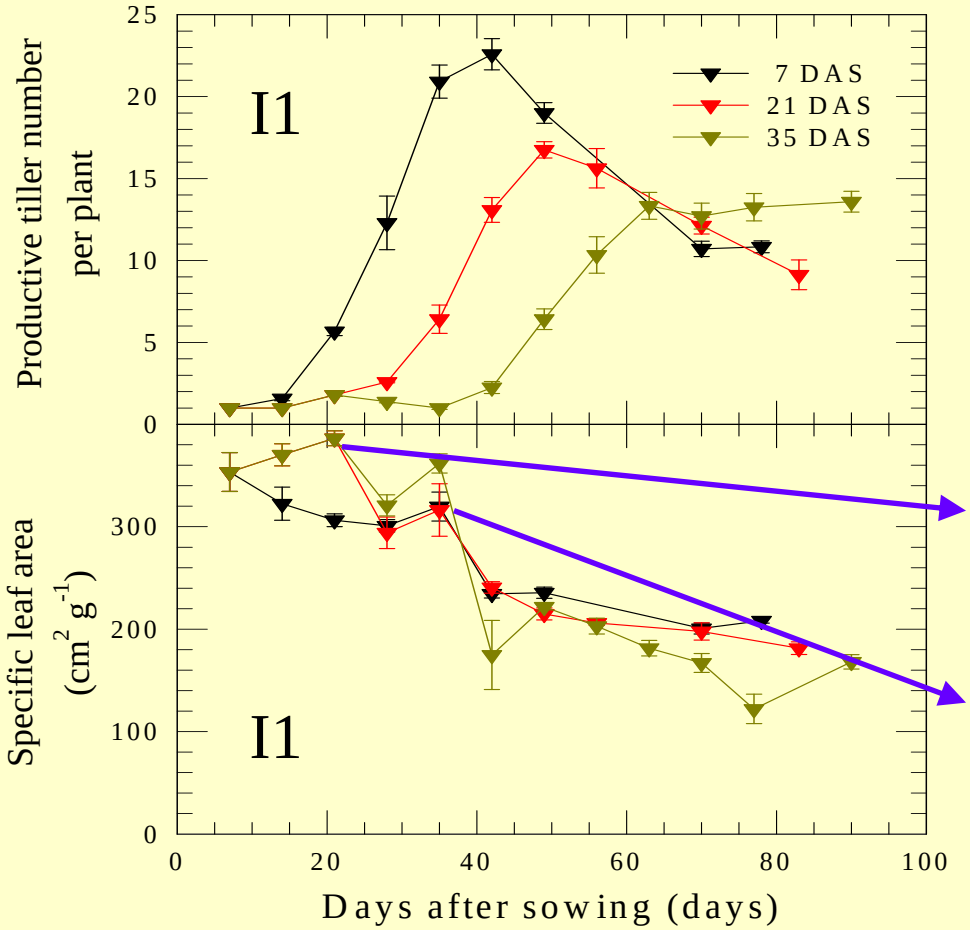

- Tiller emergence was delayed if extended stay in the nursery

- Tiller emergence resumed right after transplanting whatever the age

- SLA increased in the nursery if transplanting was delayed

- SLA resumed to the control value right after transplanting

Extended stay in the nursery affected tiller emergence

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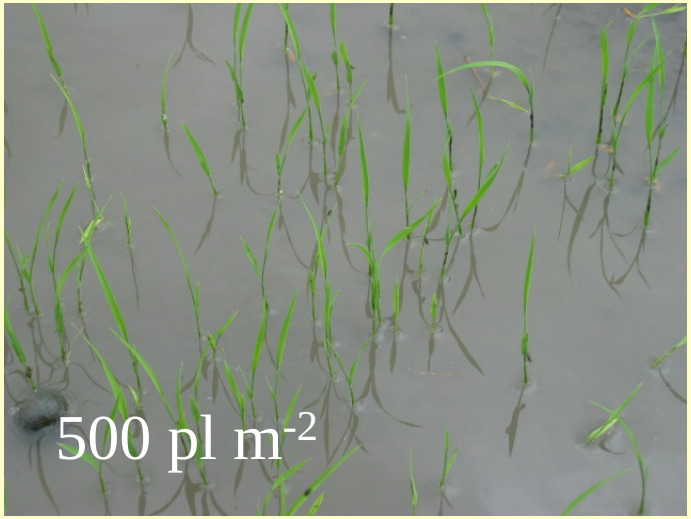
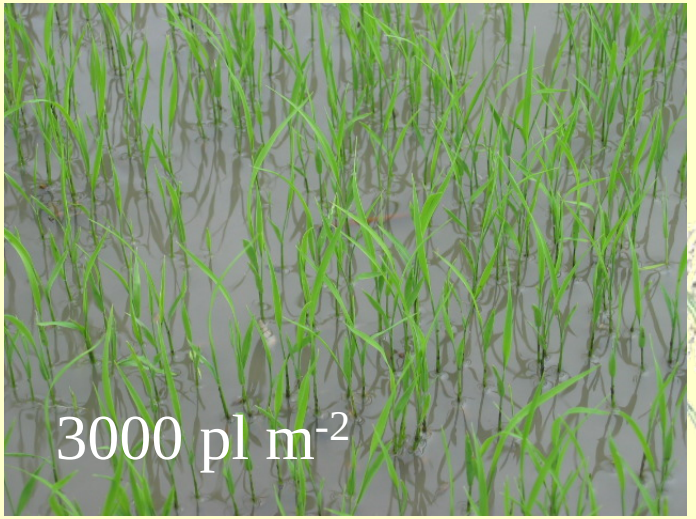
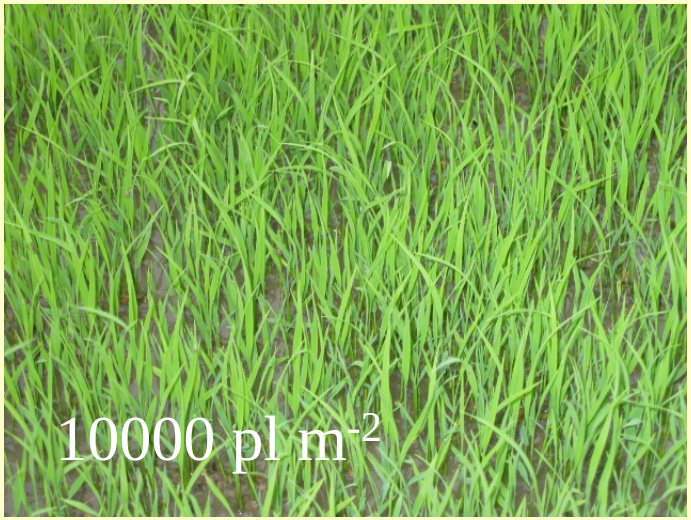
Plant response to seed density







I1 in the nursery, 6 days after sowing

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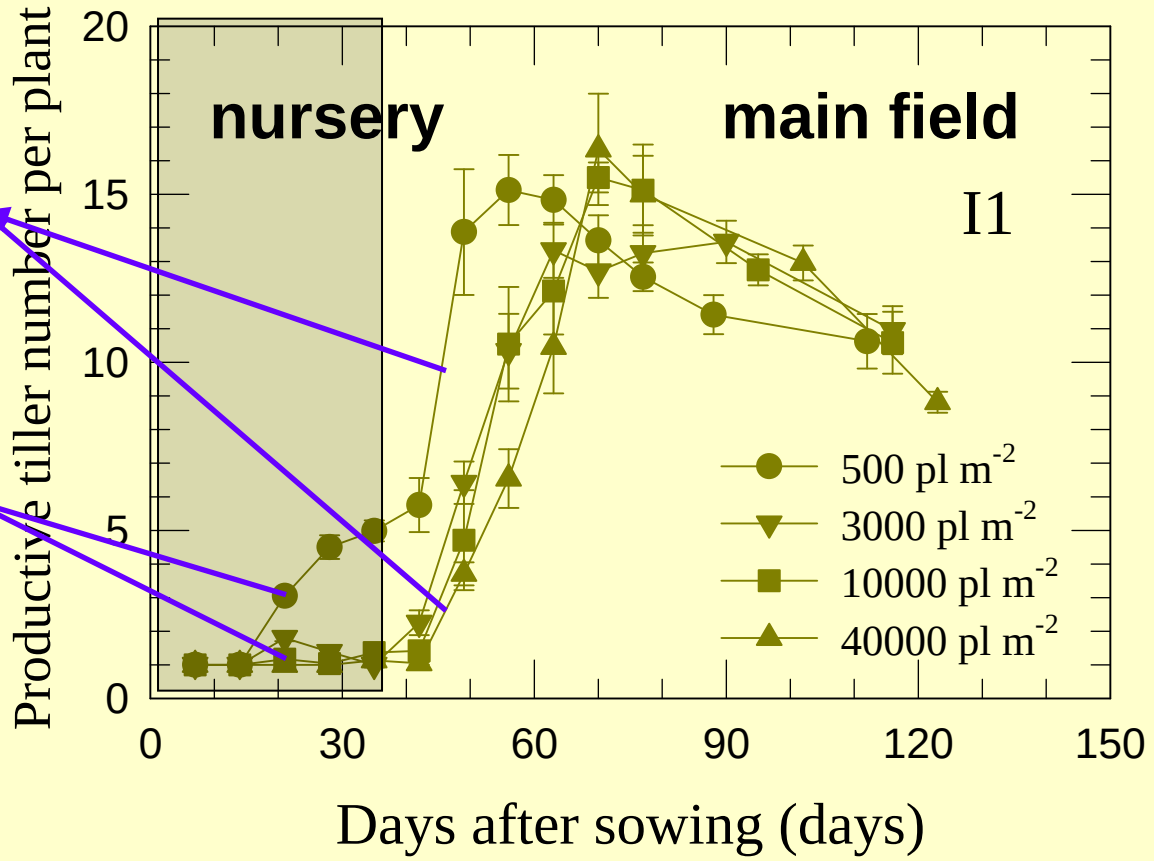
Plant response to seed density

Transplanting 35 days after sowing

-Tiller emergence resumed right after transplanting whatever the density

- Tiller emergence was delayed if high density in the nursery



High seed density in the nursery affected tiller emergence

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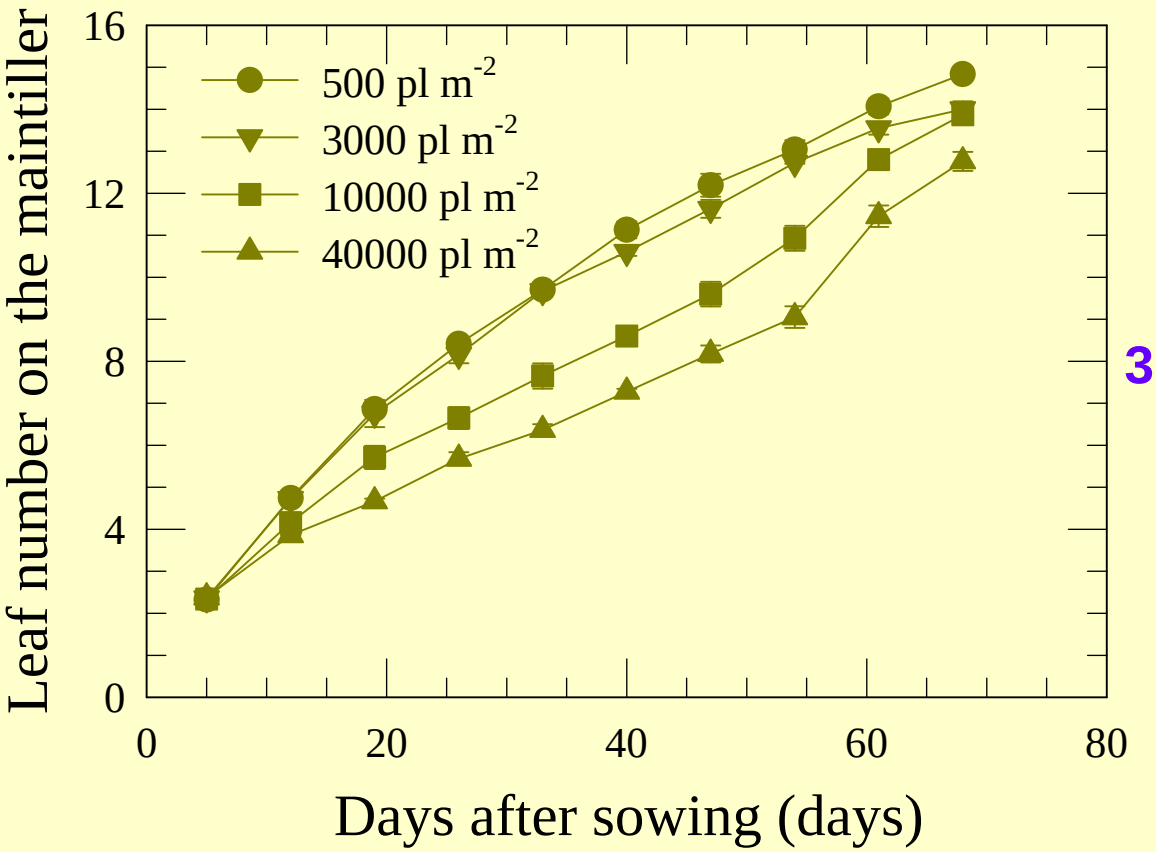
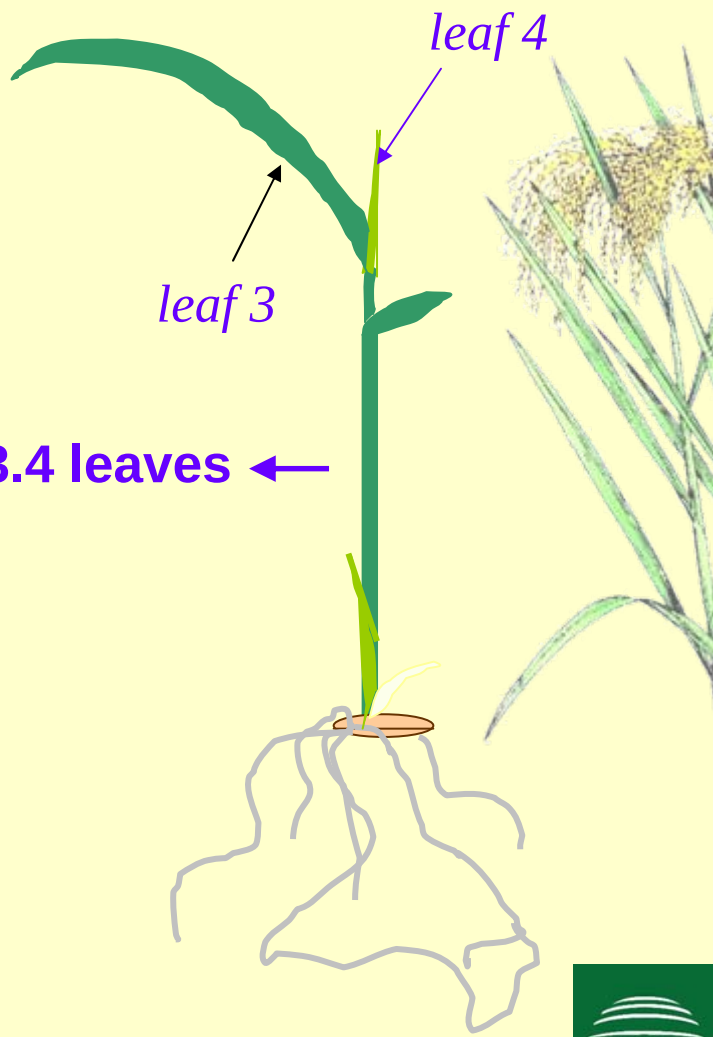
Plant response to seed density

Transplanting 35 days after sowing





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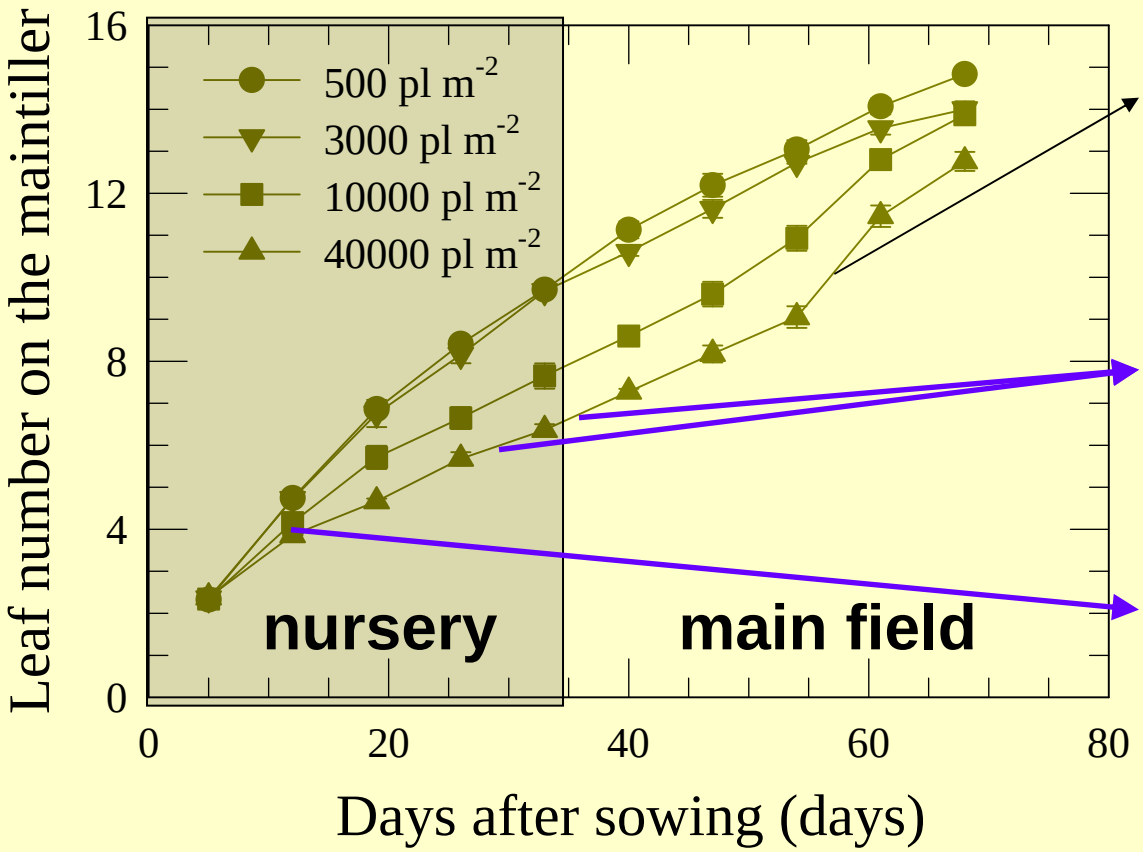
Plant response to seed density

Transplanting 35 days after sowing



- Leaf emergence recovery from competition in the nursery visible only 20 days after transplanting

- **Leaf emergence was similar before and after transplanting whatever the seed density**

- **Leaf emergence was affected in the nursery if high density**

High seed density in the nursery affected leaf emergence

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Plant response to nursery management

- **No transplanting shock was observed**
  - High seedling density in the nursery and late transplanting induced a delay in leaf and tiller emergence and an increased in SLA
  - Recovery in tiller emergence and SLA was observed right after transplanting, whatever the seed density and transplanting age were
  - Leaf emergence was not affected by transplanting

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Plant response to early transplanting

Transplanting, hill spacing 20 x 20 cm

I1 in the main field,
34 days after sowing
for all 3 situations

transplanted 7 days after sowing

transplanted 14 days after sowing

transplanted 21 days after sowing

Is there any positive effect on grain yield?

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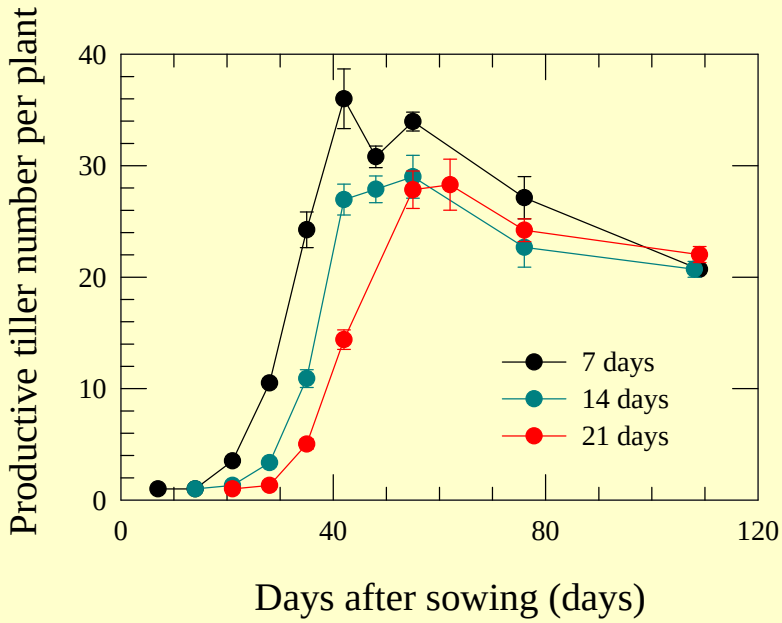
Plant response to early transplanting

Crop establishment	Grain yield (t ha^{-1})	
	I1	H1
7 days transplanting	**6.99**	**7.75**
14 days transplanting	**6.55**	**7.59**
21 days transplanting	**6.06**	**6.97**

I1: IR72 *H1: IR75217H*

- same sowing date
- same plant density
- same nutrient management



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Plant response to early transplanting

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I1: IR72 *H1: IR75217H*

- same sowing date
- same plant density
- same nutrient management

Higher grain yield with early transplanting valid for:

- contrasted genotypes
(inbreds, NPTs, hybrids)
- wet and dry seasons
(larger gap in the dry season)
- different locations
(Philippines, Indonesia,…)

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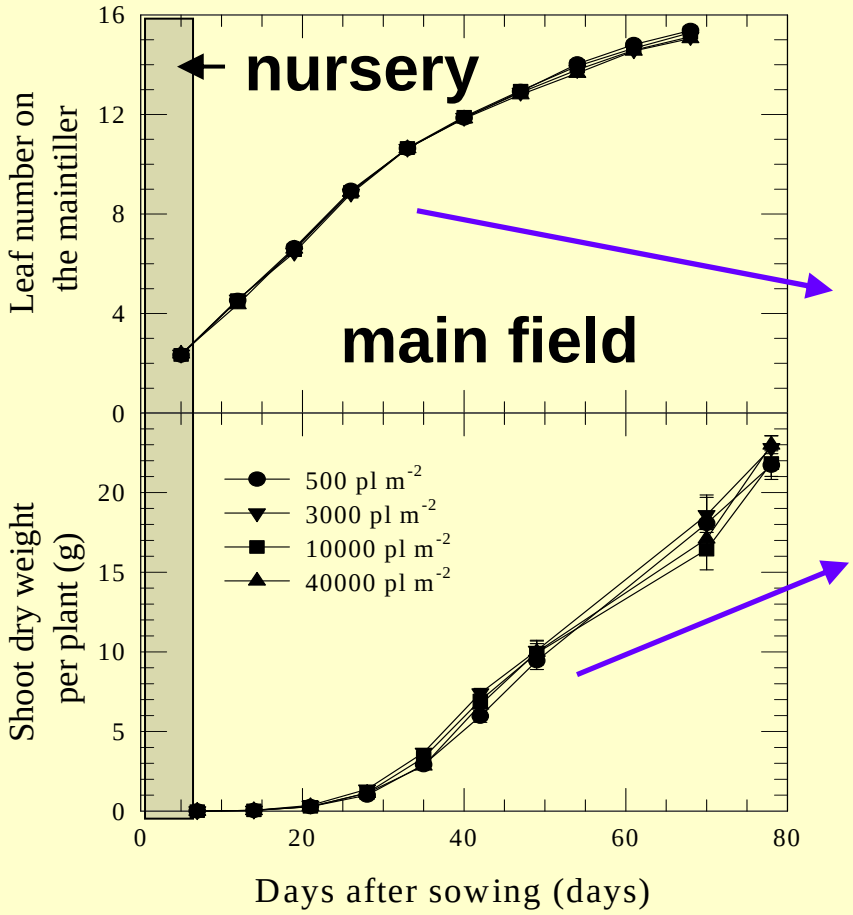
Plant response to seed density

Transplanting 7 days after sowing



For nursery densities as high as 40000 seed m^{-2}, there was:

- no impact on leaf emergence

- no impact on shoot dry matter accumulation

Early transplanting reduces the area required for the nursery

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Plant response to nursery management

- **Early transplanting induced an increase in grain yield (up to 1 t ha^{-1} in some conditions)**
- **Early transplanting shall promote a significant reduction in nursery area**
- **Early transplanting increased tiller mortality rate (for contrasted genotypes and seasons)**

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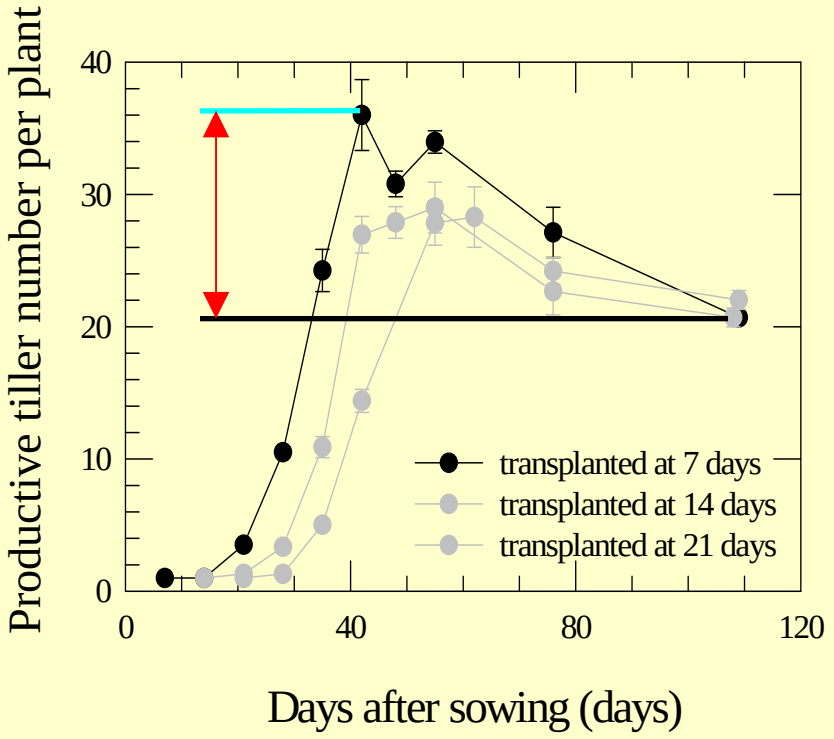
Impact of tiller mortality rate

Tiller mortality rate:

$$TMR = \frac{\text{senescent tillers}}{\text{total tillers}}$$



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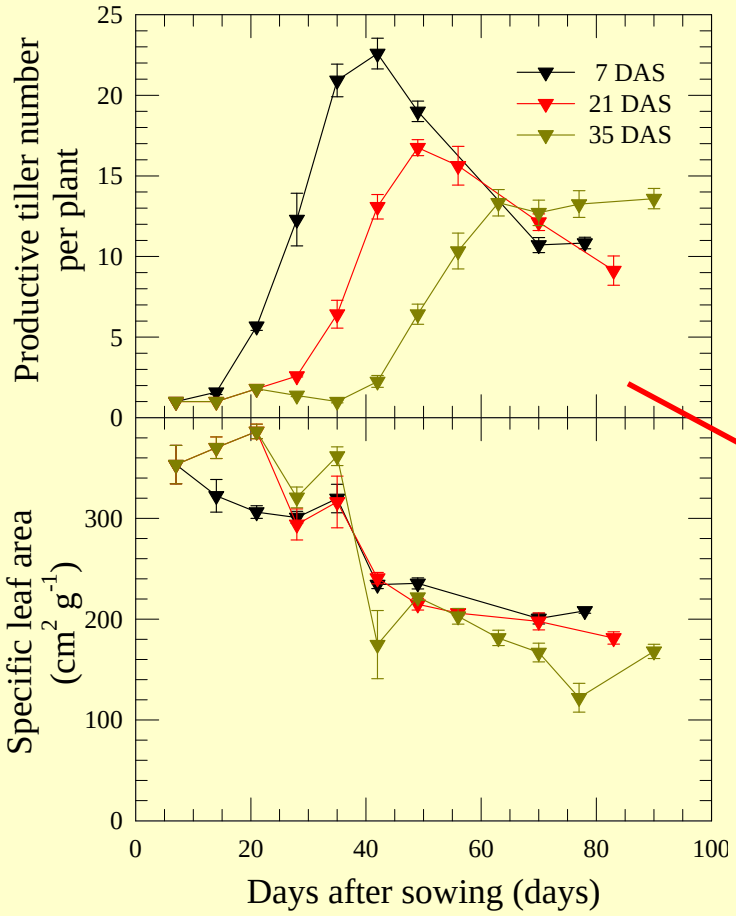
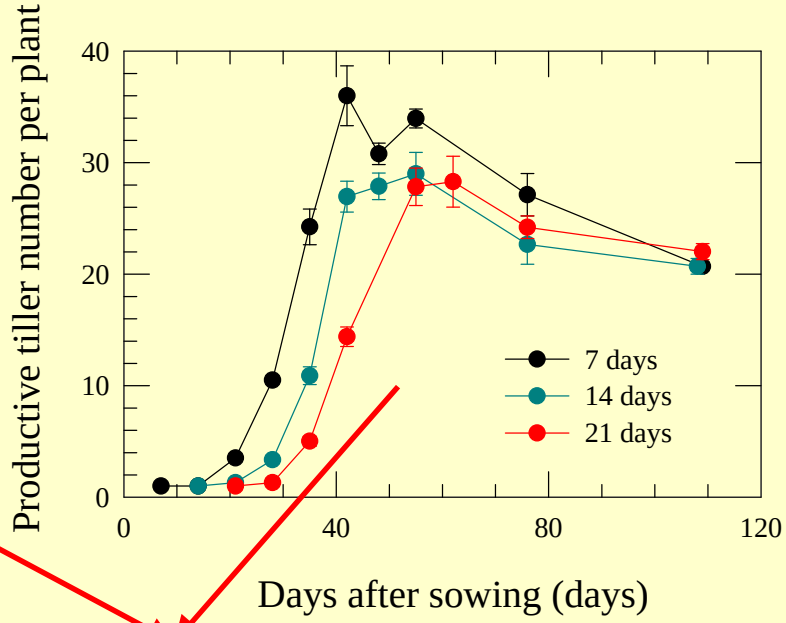
Impact of tiller mortality rate





Early transplanting was associated with high tiller mortality

Did high tiller mortality reduce the impact of the positive effect of early transplanting on grain yield?

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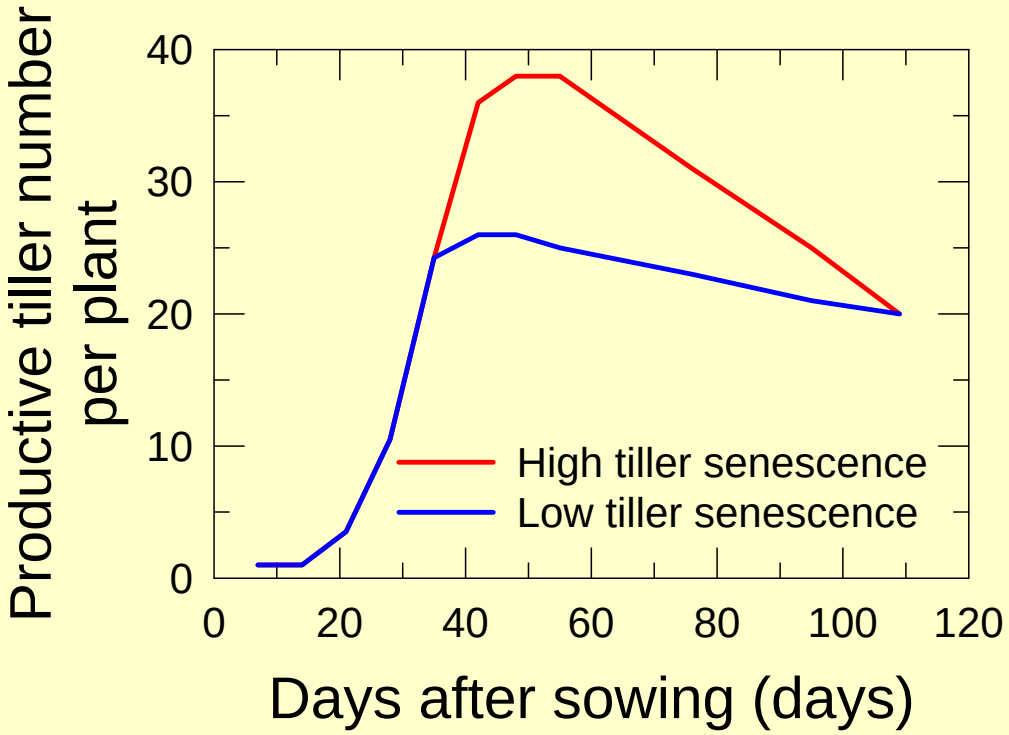
Impact of tiller mortality rate



Conceptual framework: to achieve similar tiller emergence rate and productive tiller number but contrasted tiller mortality rate

How to get this contrast in plant response?

Tiller emergence is affected by water depth

⇒ Increase in water depth at mid-tillering

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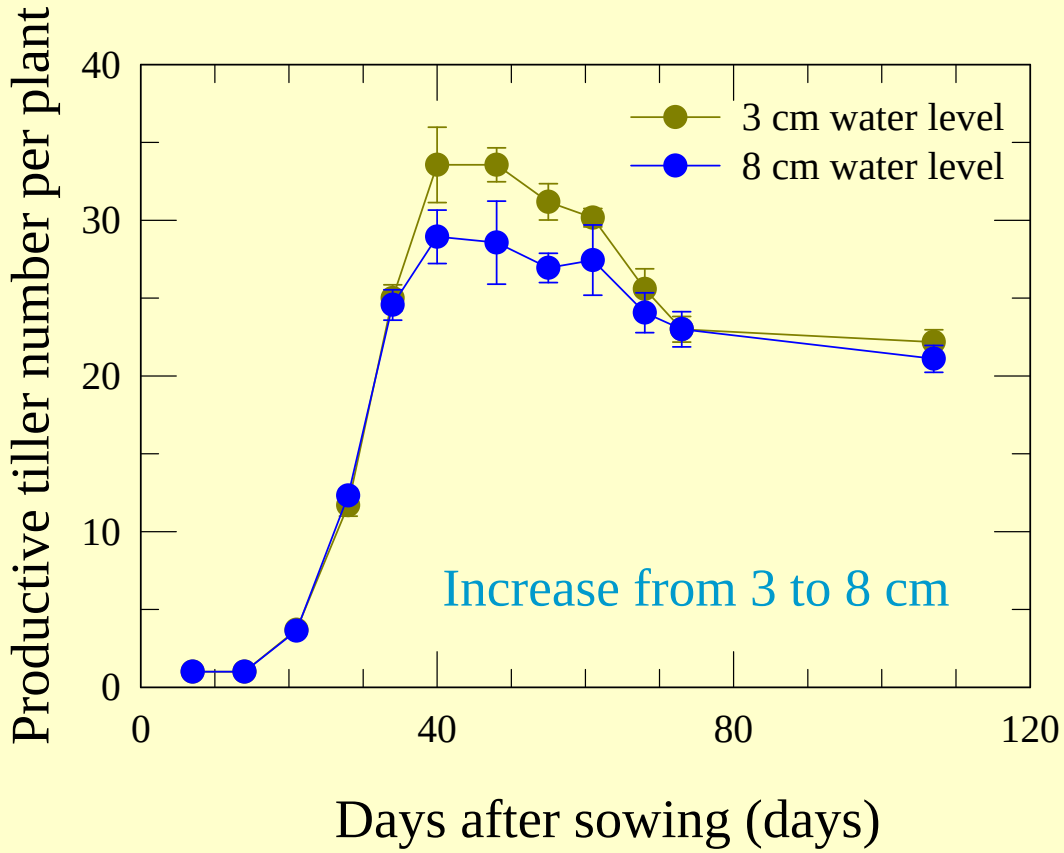
Impact of tiller mortality rate

Transplanting, hill spacing 20 x 20 cm



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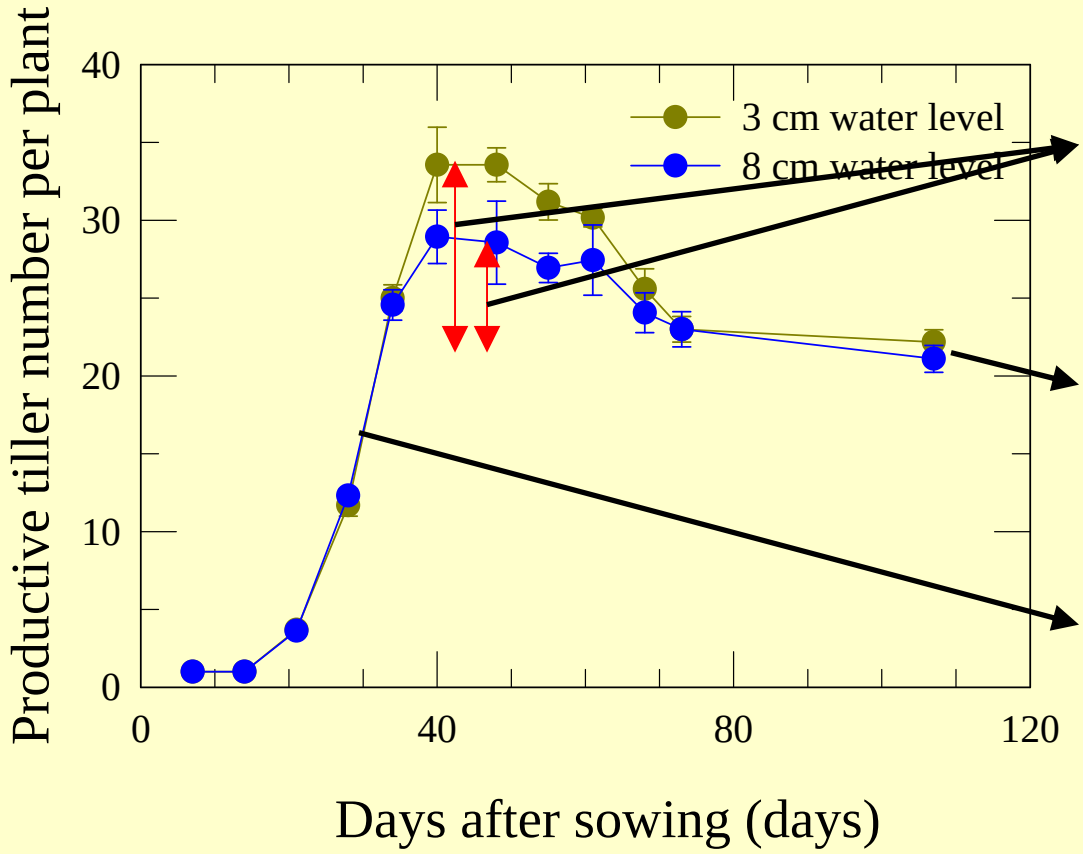

- Decrease in TMR from 0.33 to 0.24

- Similar productive tiller number

-Similar rate in tiller emergence

Has grain yield increased?

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Impact of tiller mortality rate

Genotypes	Water management	Tiller mortality rate	Grain yield (t/ha)	Tiller density (m^{-2})	Per productive tiller		Grain size (g)
					Filled grain dry weight (g)	Filled grain number	
I1	3 cm water level	**0.33**	**6.89**	554	1.60	72.2	22.2
	8 cm water level	**0.24**	**6.61**	527	1.45	64.5	22.6
H1	3 cm water level	**0.33**	**9.08**	473	2.17	91.8	23.6
	8 cm water level	**0.25**	**9.08**	465	2.20	92.3	23.8

Grain yield was unchanged for both genotypes

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Plant response to nursery management

- **High tiller mortality rate did not affect grain yield**
  - Tiller mortality:
    - concerned small tillers then low plant dry matter
    - concerned non-competitive tillers for access to light because inside the canopy
    - may have contributed to higher dry matter accumulation in productive tillers through efficient remobilization

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